EXTENDED ABSTRACT – MODELED TSUNAMI SOURCES USED IN STATE OF CALIFORNIA TSUNAMI INUNDATION MAPPING FOR EMERGENCY PREPAREDNESS

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From 2006 to 2012, utilizing funding from the National Tsunami Hazard Mitigation Program, the California Geological Survey, California Emergency Management Agency, and the University of Southern California worked on and completed maximum tsunami inundation maps for California, covering most residential and visitor populations along the state's coastline. Thirty-five separate map areas covering approximately one-half of California's coastline were selected for tsunami modeling using the MOST (Method of Splitting Tsunami) numerical tsunami model. Based on a preliminary evaluation of over fifty local and distant tsunami source scenarios, those with the maximum expected hazard for a particular populated, low-lying coastal area were input to MOST. The MOST model was run, incorporating Mean High Water, with a near-shore bathymetric grid resolution varying from three arc-seconds (90m) and one arc-seconds (30m), depending on availability. Maximum tsunami "flow depth" and inundation layers were created by combining all modeled scenarios for each area into a single line delineating "wet" from "dry." A method was developed to better define the location of the maximum inland penetration line using higher resolution digital onshore topographic data from interferometric radar sources, further refining modeled outputs. The final inundation line for each map area was validated using a combination of higher resolution modeling, digital stereo photography, and fieldwork. The result was a statewide maximum inundation line for the coast of California. Local governmental agencies have used these new maximum tsunami inundation lines to assist in the development of their evacuation and emergency response plans.

Various sensitivity analyses were used to determine which tsunami sources would impact each of the coastal areas modeled/mapped. The Cascadia Subduction Zone (CSZ) is the dominant source for the area of the coast north of Cape Mendocino, and provides a uniquely serious hazard to the northernmost coastal counties in California in that people in the inundation zone have only minutes to evacuate in response to a tsunamiemanating from a tsunami sourceimmediately offshore. Five separate CSZ scenarios with varying rupture lengths, rupture widths, and ruptures on splay-faults, were generated for modeling in this area. Based on numerical model results for areas south of Cape Mendocino, the impact of the CSZ sources decreases dramatically compared to other local and distant sources.

Non-CSZ tsunami sources that were modeled for California include:1) large subduction zone earthquakes along the Pacific Ring of Fire, 2) large earthquakes from other local, near shore or offshore faults, and 3) reactivation of various existing submarine landslides. The Alaska-Aleutian Subduction Zone is the most dominant distant tsunami source region for California's coast. Model results from an earthquake of magnitude 9.2 near the eastern Aleutian Islands demonstrate tsunami run-ups could be 7 to 9 meters for many portions of the northern and central California coast. For southern California, south of Point Conception, maximum modeled tsunami run-ups are less, in the range of 2 to 4 meters, from maximum distant source events from an Aleutian-Alaska or northern Chilean subduction zone source.

Local earthquake-generated tsunami sources south of Cape Mendocino include faults with strike-slip mechanisms like the San Gregorio, Catalina, and Newport-Inglewood faults. Though these faults don't have a significant component of vertical displacement, they do have regions of local compression or extensionnear bends in these faults where tsunamis can be generated. Examples of local earthquake sources along non-subduction zone faults that exhibit vertical displacements of the sea floor include the Point Reyes Thrust, the San Mateo Thrust, and the Channel Islands Thrust. Other potential local tsunami sources include submarine landslides in the Monterey Canyon, Goleta, Palos Verdes, and Coronado Canyon areas.

California is currently reviewing new tsunami source information about the CSZ from the State of Oregon and the USGS that better defines rupture potential and recurrence. On-going tsunami deposit investigations in California and Alaska will also provide insight into tsunami sources and their impacts. New modeling may result in updates to the tsunami inundation maps along the far north coast of the state.

Selected References:

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